

Extra Credit Report.

Submitted by:

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Question:

1. Having fun in Disneyland! A visit at Disneyland involves a fair amount of waiting in lines during the high season. One has to queue up to buy a ticket, and then once in the park, one has to queue up for each theme. Does one spend more time queueing up or enjoying the themes? That depends on the arrival rates of customers and service times (i.e. the time to see a theme). The queueing network in figure 1 depicts the ticket counters, four themes, and the food court. Answer the following questions:
 - a. Are all the queues stable?
 - b. What is the utilization of each ticket counter?
 - c. What is the probability that a customer will get served immediately upon arrival at the food court?
 - d. What is the mean waiting time at each theme?
 - e. How long would it take on the average to visit all themes once, and of that time how much one spends waiting in a queue?

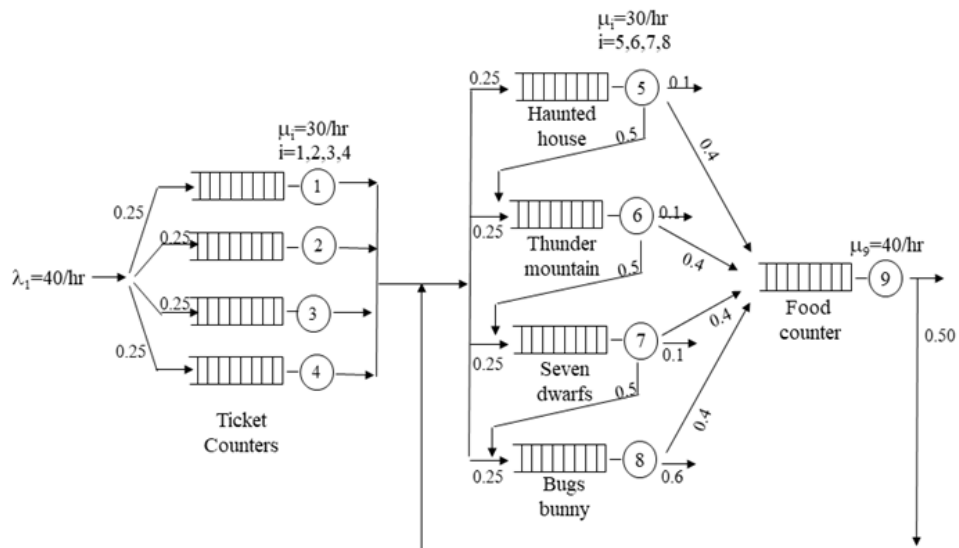



Figure 1: Having fun in Disneyland

Technology Used:

- Simulation was carried out using JMT i.e Java Modeling Tool.

Results:

Results of the simulation are inserted below.


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Throughput	Number of Customers	Residence Times	System Response Time	Utilization	System Power	Synopsis
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Throughput
Throughput of each class for each station. System Throughput is the completion rate of the **Reference Station**.

*	Aggregate	Class1
System	40.0000	40.0000
Station1	14.9495	14.9495
Station2	22.4242	22.4242
Station3	26.1616	26.1616
Station4	23.0808	23.0808
Station5	34.6465	34.6465

(Throughput Results)

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Throughput	Number of Customers	Residence Times	System Response Time	Utilization	System Power	Synopsis
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Number of Customers
Average number of customers for each class at each station.

*	Aggregate	Class1
Aggregate	20.5765	20.5765
Station1	0.9933	0.9933
Station2	2.9600	2.9600
Station3	6.8158	6.8158
Station4	3.3358	3.3358
Station5	6.4717	6.4717

(No of Customers)

Throughput	Number of Customers	Residence Times	System Response Time	Utilization	System Power	Synopsis
Residence Times Total time spent by each customer class summed across all visits to a station.						
*	Aggregate	Class1				
Station1	0.0248	0.0248				
Station2	0.0740	0.0740				
Station3	0.1704	0.1704				
Station4	0.0834	0.0834				
Station5	0.1618	0.1618				

(Residence Times)

Throughput	Number of Customers	Residence Times	System Response Time	Utilization	System Power	Synopsis
System Response Time The global aggregate is the "System Response Time" and is obtained weighting the aggregated values by the relative per-class throughput. A: This value of System Response Time includes the Residence Time of the Reference Station. B: This value of System Response Time does NOT include the Residence Time of the Reference Station. Notice: For open classes the Reference Station always coincides with the arrival process. Thus the B values are not computed.						
*	Aggregate	Class1				
A	0.5144	0.5144				
B	--	--				

(System Response Time)

Throughput	Number of Customers	Residence Times	System Response Time	Utilization	System Power	Synopsis
Utilization Utilization of a customer class at the selected station. The utilization of a delay station is the average number of customers in the station (it may be greater than 1).						
*	Aggregate	Class1				
Station1	0.4983	0.4983				
Station2	0.7475	0.7475				
Station3	0.8721	0.8721				
Station4	0.7694	0.7694				
Station5	0.8662	0.8662				

(Utilization Results)

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Throughput | Number of Customers | Residence Times | System Response Time | Utilization | **System Power** | Synopsis

System Power
Aggregate System Power: Aggregate System Throughput (sum of the per-class throughputs) divided by the Aggregate System Response Time (sum of the Response Times per class weighted by the relative throughputs).
Per-class System Power: Throughput divided by the Response Time of each class.
A: This value of System Power is computed using the value of System Response Time that **includes** the Residence Time of the Reference Station.
B: This value of System Power is computed using the value of System Response Time that **does NOT include** the Residence Time of the Reference Station.
 Notice: For **open classes** the Reference Station always coincides with the arrival process. Thus the **B** values are not computed.

*	Aggregate	Class1
A	77.7584	77.7584
B	--	--

(System Power Results)

Calculations:

- a - Are all the queues stable?
 - *Yes the queues are stable*

Here we can see that throughput is less than μ for every queue. $\mu_1 = \mu_2 = \mu_3 = \mu_4 = 30$ and $\mu_5 = 40$.

So all the queues are stable

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Throughput | Number of Customers | Residence

Throughput
Throughput of each class for each station. System

*	Aggregate	Class1
System	40.0000	40.0000
Station1	14.9495	14.9495
Station2	22.4242	22.4242
Station3	26.1616	26.1616
Station4	23.0808	23.0808
Station5	34.6465	34.6465

- c - What is the probability that a customer will get served immediately upon arrival at the food court?

$$P_0 = 1 - \rho$$

$$\rho = 0.8662$$

$$P_0 = 1 - 0.8662 = 0.1338$$

Utilization
Utilization of a customer class at the select

*	Aggregate	Class1
Station1	0.4983	0.4983
Station2	0.7475	0.7475
Station3	0.8721	0.8721
Station4	0.7694	0.7694
Station5	0.8662	0.8662

d - What is the mean waiting time at each theme?

- $M1 = 0.0248$
- $M2 = 0.0740$
- $M3 = 0.1704$
- $M4 = 0.0834$
- $M5 = 0.1618$

Residence Times		
Total time spent by each customer class sur		
*	Aggregate	Class1
Station1	0.0248	0.0248
Station2	0.0740	0.0740
Station3	0.1704	0.1704
Station4	0.0834	0.0834
Station5	0.1618	0.1618

e - How long would it take on the average to visit all themes once, and of that time how much one spends waiting in a queue?

- Average time to visit all themes once = $(0.0248 + 0.0740 + 0.1704 + 0.0834 + 0.1618) = 0.5144$